

REMARKS/ARGUMENTS

The Examiner has withdrawn Claims 5, 14-25, and 39-50 from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention/species. Applicant respectfully requests that the withdrawn claims 14-25 and 39-50 be reinstated as they now have a generic linking claim. Each of independent claims 14 and 27, as amended, are now limited to the elected Group I.

The Examiner rejects claims 11 and 30 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. According to the Examiner, claims 11 and 30 recite groups of compounds in improper Markush format because “it is improper to use the term ‘consisting essentially of’ instead of ‘consisting of.’” The Examiner cites MPEP 2173.05(h) for this proposition.

Applicants disagree. MPEP 2173.05(h) does not support the Examiner’s conclusion. MPEP 2173.05(h) states simply that “[a]lternative expressions are permitted if they present no uncertainty or ambiguity with respect to the question of scope or clarity of the claims.” The expression “consisting essentially of” has been found to be an acceptable expression of a Markush group. In re Garnero, 412 F.2d 276, 162 USPQ 221 (CCPA 1969); In re Bandel, 348 F.2d 563, 146 USPQ 389 (CCPA 1965); Ex parte Hoffman, 12 PQ2d 1061 (BPAI 1989); Ex parte Sheperd, 185 USPQ 480 (POBA 1974).

The Examiner rejects Claims 1-4, 6-13, and 26-37 under 35 U.S.C. § 102(b) as being anticipated by Shin et al. (U.S. 4,410,751) with Shih et al. (U.S. 6,734,131) to demonstrate an inherent state of fact; claims 1-4, 6-13, 26-35, and 37-38 under 35 U.S.C. § 102(b) as being anticipated by Kametaka et al. with Shih et al. to demonstrate an inherent state of fact; claims 1-4, 6-13, and 26-37 under 35 U.S.C. § 102(b) as being anticipated by JP 59-216631; and claim 36 under 35 U.S.C. § 103(a) as being unpatentable over Kametaka et al. with Shih et al. to demonstrate an inherent state of fact as applied above for claims 1-4, 6-13, 26-35, and 37-38.

The cited prior art fails to teach or suggest at least the following italicized features of the independent claims:

1. A sorbent particle, comprising:
a substrate having an ion exchange capacity of at least about 50 mEq/100g and a plurality of ion exchange sites; and
a plurality of *disordered* polyvalent metal oxides located at the plurality of ion exchange sites, *wherein the polyvalent metal oxide comprises at least about 5 wt.% water of hydration.*

14. In a process for *treating a fluid comprising at least one ionic contaminant, comprising providing a sorbent and contacting the fluid with the sorbent to remove at least most of the at least one ionic contaminant from the fluid to form a treated fluid and an ionic contaminant-bearing sorbent*, the sorbent comprising:
a *disordered* polyvalent metal oxide located on only a portion of the surface area of a vermiculite substrate.

27. A method for manufacturing a sorbent, comprising:
(a) contacting a solution comprising dissolved polyvalent metal ions with a substrate having a plurality of ion exchange sites to form an ion exchanged substrate having polyvalent metal ions exchanged at the plurality of ion exchange sites, *wherein the solution has an acidic pH*; and
(b) *contacting the ion exchanged substrate with an oxygen-containing fluid to convert at least most of the polyvalent metal ions exchanged at the plurality of ion exchange sites into metal oxides.*

39. In a system for purifying an aqueous stream, *the system comprising a vessel comprising a bed of sorbent; an input into the vessel for the aqueous stream; and an output from the vessel for a treated aqueous stream*, each of the sorbent particles in the sorbent bed comprising:
a substrate having an ion exchange capacity of at least about 50 mEq/100g; and
a plurality of ion exchange sites and a plurality of *disordered* polyvalent metal oxides located at the plurality of ion exchange sites, *wherein the polyvalent metal oxide comprises at least about 5 wt.% water of hydration.*

Shin et al.

U.S. 4,410,751 to Shin et al. discloses a catalyst to catalyze the conversion of lower alcohols, such as methanol or dimethyl ether, under pyrolysis conditions to lower olefins. The catalyst includes a smectite, such as montmorillonite clay, having superimposed aluminosilicate layers and zirconium oxide intercalated between the structural, aluminosilicate layers. The catalyst is produced by dispersing the smectite in a solution containing a zirconium compound

capable of providing hydroxy-zirconium cation, which is ion-exchanged for cations originally in the smectite. The cation-exchange reaction is performed at a temperature of up to 100°C. Although unstated, the pH of the reaction is basic because the cations are exchanged in the form of hydroxy compounds. The resulting smectite is then dried and thermally treated at a temperature of 100 to 700°C, preferably 300 to 600°C, to convert the hydroxy-zirconium cation into zirconium oxide by dehydroxylation. The thermal treatment of the ion-exchanged smectite will cause the level of hydration of the smectite to be less than 5 wt.% water. Moreover as a result of the thermal treatment, the ion-exchanged metal oxide will be substantially microcrystalline. In the present invention, the polyvalent metal oxide is substantially nanocrystalline. Shin et al. says nothing about using vermiculite as a substrate.

Kametaka et al.

U.S. 4,278,820 to Kametaka, et al., is directed to a solid catalyst for catalyzing the conversion of an alkylene oxide with an alcohol to form a monoalkylene glycol monoether. The catalyst includes a montmorillonite having a metal cation from the group aluminum, chromium, manganese, iron, tin, and thorium ion exchanged for the native cations in the clay. The catalyst is produced by contacting the clay with an aqueous salt solution including the selected metal cation. After formation, the ion exchanged substrate is dried at a temperature of from about 100 to about 120°C and later calcined at a temperature of about 300 to about 600°C.

Kametaka fail to teach the formation of polyvalent metal oxides. Rather, the ion exchanged cations in the montmorillonite are maintained in the form in which they are originally exchanged, namely as a metal salt.

The thermal treatment of the ion-exchanged montmorillonite will cause the level of hydration of the smectite to be less than 5 wt.% water. Moreover as a result of the thermal treatment, the ion-exchanged metal oxide will be substantially microcrystalline. Kametaka et al. says nothing about using vermiculite as a substrate.

JP 59-216631

Based on the English abstract, JP 59-216631 is directed to a catalyst to efficiently synthesize lower olefin from synthetic gas. The catalyst is a smectite having tri-nuclear iron acetate and/or iron oxide ion exchanged to the interlayer of the smectite. Ion exchange is effected by contacting the smectite with an iron acetate ion-containing salt solution. Iron acetate cations are exchanged with cations resident in the smectite. The ion-exchanged smectite is heated to a temperature of 340 to 500°C to convert the iron acetate cations to iron oxide.

The thermal treatment of the ion-exchanged montmorillonite will cause the level of hydration of the smectite to be less than 5 wt.% water. Moreover as a result of the thermal treatment, the ion-exchanged metal oxide will be substantially microcrystalline. In the present invention, the polyvalent metal oxide is substantially nanocrystalline. JP 59-216631 says nothing about using vermiculite as a substrate.

Shih et al.

U.S. 6,734,131 to Shih et al. is directed to a chromium containing catalyst in which the chromium atom is in one of its higher valence states and is immobilized to a support-agglomerate composed of at least one inorganic oxide component and at least one ion-containing layered component. The catalyst is a composite or support-agglomerate of a porous inorganic oxide in the form of a gel (preferably silica gel having its pores filled with water) (component A) coated on a layered clay mineral, such as the smectite montmorillonite (component B). The chromium precursor salt component is made part of the gel structure by admixing the chromium precursor with the silica hydrogel before milling and/or prior to agglomeration by spray drying. The clay mineral may be pre-treated with a salt solution to substitute hydroxide anions into the layered structure. In one clay pre-treatment, the clay is ion-exchanged and heated to a temperature between about 500 to about 700°C. The agglomerates are made by spray drying an intimate admixture of A and B. The layered clay mineral may be dry milled followed by flash drying at 370 to 537°C or wet milled. The product of the support-agglomerate that has been treated with chromium precursor is subjected to oxidation after agglomeration to oxidize the chromium atom to a higher oxidation state. Oxidation is performed by heating the chromium precursor treated

support agglomerate to temperatures of typically from about 600 to about 1800°F (316 to 985°C). Immobilization of the chromium precursor may be “by reaction of the precursor species in the clay mineral with residual hydroxyl groups *contained in the support-agglomerate.*” (Col. 9, lines 6-12 (emphasis supplied).)

The thermal treatment of the support-agglomerate will cause the level of hydration of the smectite to be less than 5 wt.% water. Moreover as a result of the thermal treatment, the ion-exchanged metal oxide will be substantially microcrystalline. In the present invention, the polyvalent metal oxide is substantially nanocrystalline. Shih et al. says nothing about using vermiculite as a substrate.

In a number of rejections, the Examiner states that:

The disorganized and poorly crystallized structure of the metal oxides, and the water of hydration present in the metal oxide structure are not disclosed by [the prior art]. However, the disclosed reference discloses the same process of making using the same or similar starting materials. Therefore, it is the position of the examiner that the resulting product would inherently have the same structure.

(Office Action at pages 3-4.)

The Examiner ignores the fact that the preferred manufacturing process of the present invention is different from those disclosed in the prior art. The prior art fails to disclose the collective steps of contacting an ion-exchangeable substrate with a salt *and* contacting the ion-exchanged substrate with a fluid containing hydroxyl ions. (See Specification at pages 15-19 and Fig. 3.) The sorbent of the present invention is not subjected to elevated temperatures as in the catalyst manufacturing processes of the prior art. As set forth in the Declaration of Thomas Broderick filed concurrently herewith, the use of elevated temperatures materially and substantially changes the sorbent chemistry.

Thus, it is simply not true that the product of the prior art is inherently the same as the sorbent of the present invention.

Accordingly, the amended claims are allowable.

The dependent claims provide additional reasons for allowance.

By way of example, dependent claims 2, 7, 18, 32, and 40 require, *inter alia*, the metal oxide to be in the form of a metal hydroxide. As noted in the Broderick Declaration, the use of a high temperature heating step would convert any hydroxides to nonhydroxides.

Dependent claims 8, 10, 16, 35 and 42 are directed generally to the placement of a plurality of sorbent particles on a carrier substrate, such as a grain of sand. This embodiment can provide a bed of sorbent particles of a desired degree of porosity and permeability.

Dependent claims 10, 24, and 37 require the metal oxide to include $\text{FeO}(\text{OH})$. As noted in the Broderick Declaration, the use of a high temperature heating step would convert any hydroxides to nonhydroxides.

Dependent claims 9, 22, 34, and 41 are generally directed to the ion-exchange of a plurality of differing types of polyvalent metals into the substrate to provide a relatively pH-insensitive sorbent. Each of the metals can be selected to be operative over a selected pH range of the contaminated solution to be treated.

Dependent claim 35 requires the polyvalent metal oxide to be discontinuously distributed over the substrate

Dependent claim 28 requires the polyvalent metal ions in step (a) to be in the form of a salt in the solution, step (b) to follow step (a), and, in step (b), the ion exchanged substrate to be contacted with a source of hydroxyl ions to convert the ion-exchanged polyvalent metal ions into hydroxyl ions.

Dependent claim 30 requires the polyvalent metal to be selected from the group consisting essentially of zirconium, aluminum, lanthanum, titanium, manganese, tin, iron, zinc, tungsten, and mixtures thereof, the solution in step (a) to have a pH of less than about pH 2, and the fluid in step (b) to be a liquid, and the liquid to have a basic pH.

Dependent claim 31 requires the polyvalent metal to be a transition metal, the polyvalent metal to be electropositive, the solution in step (a) to have a pH of less than about pH 2, the fluid in step (b) to be a liquid, and the liquid to have a pH ranging from about pH 7 to about pH 8.

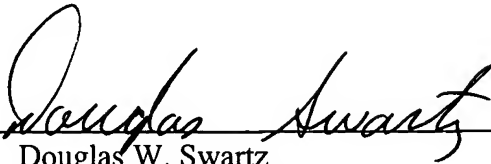
Based upon the foregoing, Applicants believe that all pending claims are in condition for allowance and such disposition is respectfully requested. In the event that a telephone

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conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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Date: Nov. 28, 2005

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